meteorological, geological, geographical and anthropological observations, as well as others dealing with ancient marks, boundaries and buildings, customs and trades.

The journal is an excellent example of all that the organ of a field club and county natural history society should be. It fulfils a double function, recording interesting observations which would otherwise have been forgotten, and stimulating its members to make fresh efforts in their own districts. Throughout every county opportunities for observation are continually occurring, opportunities which are often wasted for want of an alert local naturalist. A fresh cutting made on a railway, a new gravel pit opened, an old house pulled down, afford the chance of interesting and often valuable observations when the keen and trained observer is on the spot. The encouragement of such work is of no less importance for the progress of science than the comprehensive papers by acknowledged leaders of their subject which appear in the *Essex Naturalist*. These would be published under any circumstances, whereas the former are rescued from the multitude of observations which might have been.

The journal is exceedingly well printed, and is a model of careful and successful editorship. E. B. P.

Anleitung zur Darstellung chemischer Präparate. Ein Leitfaden für den praktischen Unterricht in der Anorganischen Chemie. Von Prof. Dr. H. Erdmann. Second edition. 92 pp. (Frankfort: H. Bechhold, 1899.)

THE great educational value of a well-chosen set of chemical preparations, as an adjunct to the usual analytical courses, is now generally admitted; it has been, however, usual to select the examples almost wholly from the field of organic chemistry. To Prof. Erdmann is due the credit of showing that a course of inorganic preparations was not only feasible, but on account of the greater variety of difficulties met with in many cases, even preferable for educational purposes to a selection wholly organic. In this second edition several additions have been made to the original text, including the preparation of ammonium perborate, dry aluminium chloride, arsenious oxide, violet chromium sulphate and potassium iodate.

The instructions throughout are very practical, the cost of the material having been borne in mind throughout, many laboratory bye-products or residues being utilised as the raw material for preparations.

In the few instances where the methods given are not the best available, the residues are worked up in other preparations. The book as a whole fills a gap in chemical literature.

The Boyhood of a Naturalist. By Fred Smith. Pp. vi + 227. (London: Blackie and Son, Ltd., 1900.)

THIS genial account of his boyhood by a naturalist, writing under the pseudonym Fred Smith, will afford unlimited interest to any youngster with a love for live things. That Fred Smith did not shine in school, and was only with difficulty made to play cricket fairly regularly, rather adds to his winsomeness. Indirectly, the book should prove useful in demonstrating the educational value of the study of nature at first-hand. Fred's education was unmistakably of the kind which it is at present fashionable to call "heuristic," and his progress in his numerous researches is further evidence of the possibility of a boy, though considered a dunce at school, arriving at manhood educated in the better sense of the term, since his faculties are properly trained and his perceptions keenly alert. As a gift book for a child with a natural proclivity for biological work the volume can be thoroughly recommended; it is both instructive and amusing.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The New Zealand Zoological Region.

IN a paper on "The Geography of Mammals" (*Geographical Journal*, vol. iii. p. 95, and vol. iv. p. 35, 1894), Mr. W. L. Sclater divides the land surface of the earth into three great divisions, Notogœa, Neogœa, and Arctogœa, and these are subdivided into six regions, the Australian region corresponding with the division Notogœa. It seems to me, however, that had Mr. Sclater considered what is natural rather than what is convenient, he would have divided his Notogœa into two regions, separating the New Zealand area from that of Australia, for these two areas are essentially distinct from one another in all their great fundamental zoological characteristics. According to Mr. Sclater, Prof. Huxley and Prof. Newton make the New Zealand area a primary zoological region (I have not seen the "Dictionary of Birds" or Huxley's paper). Mr. Sclater then says: "there is, no doubt, as has just been shown, a good deal to be said for this proposal; but, on the other hand, there are even more valid reasons for retaining New Zealand as a sub-region of the Australian region." Mr. Sclater then states his "more valid regions," which are three in number. The first is that as he is dealing with mammals only it would be absurd to give a small group of islands, which is almost entirely without terrestrial mammals, the rank of a primary region. Had Mr. Sclater therefore left the New Zealand area out of his considerations altogether, as was wisely done by Mr. P. L. Sclater in his lecture "The Geographical Distribution of Mammals" (Manchester Science Lectures, No. 5, Sixth Series, 1874), I should have been entirely in accordance with him, and there would have been no occasion for this paper.

The second reason given is that of "practical convenience." It seems to me, however, that convenience should only be a secondary consideration, and that what is natural is far more important. Mr. Sclater goes on to say that "other small insular areas might with some justice put forward nearly similar claims."

New Zealand, however, stands alone in its very remarkable physical and biological conditions, and presents with those of Australia the strongest contrasts rather than similarities.

It is, however, to Mr. Sclater's third reason that I have more especially to take exception. He says: "Although New Zealand possesses no indigenous terrestrial mammals, yet the fauna, such as it is, shows an unmistakable affinity of various degrees to that of Australia, and more especially to the tropical parts of that continent. It is, indeed, probable that the whole of the fauna of New Zealand has been originally derived from that source."

There are no doubt affinities between the faunas of Australia and New Zealand; but when we consider that in Tertiary times (probably Pliocene) the New Zealand land area extended far to the north and west of its present limits, probably as far as Lord Howe Island, and the facilities for the diffusion of species from the one area to the other were immensely greater than they are at present, the wonder is that these affinities are so slight and insignificant. It has been usual to look for similarities in the faunas, and to attach much importance to the occurrence of the same or representative species in both areas, and the great and essential differences of the faunas as a whole have been largely lost sight of or little understood.

I would first remark that the presence in Australia of a rich mammal fauna (marsupials and monotremes), and its total absence from New Zealand, is certainly significant. But let that pass, and, as Mr. Sclater has himself suggested, to determine the geographical affinities of New Zealand we must take "the fauna such as it is," consisting of birds, reptiles and other lower groups; and when we do this we find that the result is exactly opposite to what Mr. Sclater would lead us to expect.

Prof. Newton has no doubt ably dealt with the affinities of the New Zealand birds in his work, "Dictionary of Birds"; I need not therefore discuss them here, except to remark that one of the most interesting and remarkable features of our bird fauna is the fact that during recent times—at most a few hundred years back—there existed in these lands numerous species of

two families of raft-breasted birds, *Dinornithidae* and *Apterygidae*, which are so essentially distinct in structure that they are probably not even distantly related to one another, but have arisen quite independently, and no representatives of these families have been found in any other country. (The supposed finding of *Dinornis* and *Apteryx* remains by Mr. De Vis in Queensland, having been discussed by Captain Hutton and Mr. Lydekker, is now considered to have been a mistake.)

As regards the reptiles, we have the well-known and peculiar Tuatara (*Hatteria punctata*) and a number of lizards, which Messrs. A. H. S. Lucas and C. Frost have recently revised, and they tell us that the New Zealand forms are not related to those of Australia (*Trans.* New Zealand Institute, vol. xxix. p. 264).

The land and fresh-water molluscs have been critically revised by Mr. H. Suter; and Mr. H. Crosse, in his introductory note to Mr. Suter's paper, summarises his conclusions thus:—"Les faunes malacologiques Australienne et Néo-Zélandaise sont, d'ailleurs, à première vue, fort différentes l'une de l'autre, et elles présentent souvent des caractères opposés. . . . En réalité, les Mollusques terrestres et fluviatiles de la Nouvelle-Zélande, et nous comprenons sous cette dénomination, non seulement les deux grandes îles du Nord et du Sud, mais encore les îles Stewart, Auckland, Campbell, et Kermadec, forment un ensemble d'espèces très particulières, toutes, ou à peu près toutes, indigènes, et constituant une faune locale, insulaire et parfaitement caracatérisée.

"Pourtant, à notre avis, il existe un archipel, dans la faune duquel, si originale qu'elle soit, on trouve des affinités marquées et des rapports incontestables avec celle de la Nouvelle-Zélande: c'est la Nouvelle-Calédonie" (*Journal de Conchyliologie*, 1894, vol. xli. pp. 215, 216).

Mr. C. Hedley has also pointed out that the land molluscan fauna of New Zealand is quite distinct from that of Australia, and has affinities rather with the faunas of Lord Howe Island, New Caledonia, Fiji, the New Hebrides, and Solomon Islands (*Records* Australian Museum, vol. i. No. 7, 1891; *Proc.* Linn. Soc. N.S.W., 1892 (2), vol. vii. p. 335; *Ann. and Mag. Nat. Hist.*, 1893 (6), vol. xi. p. 435). This is indeed significant, especially when the form of the "New Zealand Plateau" and the ocean-floor beyond is taken into consideration.

As regards the earthworms, Dr. Benham tells us that they "are very different from those of Australia, on the one hand, and Europe on the other" (*Canterbury Weekly Press*, May 3, 1899). I cannot, however, agree with Dr. Benham when he reasons that because species of one genus—*Acanthodrilus*—which is widely spread in other southern lands, are found in New Zealand and Queensland there must have been at one time a land connection between New Zealand and north-eastern Australia. There is another explanation which appears to accord better with the distribution of other groups, if a land connection is necessary. Far back in Cretaceous or early Tertiary times (Cretaceo-Tertiary of N.Z. geologists) before the north-eastern part of Australia had received its mammal fauna, the New Zealand area may have been connected with New Guinea *via* Lord Howe Island, New Caledonia, the New Hebrides, and the Solomon Islands; or more probably these islands were then connected with New Guinea and the main land, and afterwards when the land connection was broken up, some of them became connected with New Zealand, so that a few of the plants and animals which spread into Australia or northwards into New Guinea were also able to reach New Zealand. This is not a new suggestion; it has been proposed by Captain Hutton and others. Mr. H. Deane, in his presidential address, delivered before the Linnean Society of New South Wales, March 31, 1897, said:—"The difficulties are too great in the way of such a supposition (a Pacific continent), but only connections similar to that which we are certain existed between New Zealand, New Caledonia, the Fijis and the main land which was perhaps at its period of greatest development in a state of oscillation need be conceded." Regarding the alpine flora of the Owen Stanley Range in New Guinea, the late Baron Sir F. von Mueller, after enumerating a number of extra-tropical genera found there, said: "Many of these approach in their affinity to forms familiar to us in Europe, a few even being identical with British species, and appear thus to reach in New Guinea their most southern geographic limits. But, on the other hand, many of these Papuan highland plants are of far southern type, such as Drimys, Drapetes, Donatia, Styphelia, Phyllocladus, Libertia, Carpha, Oreobolus, Gahnia, Dawsonia; indeed, some of the species are absolutely the same as congeners of the Australian and New Zealand Alps" (*Proc.* Roy. Geographical Soc., Australia, Queensland Branch, vol. v. p 20, 1889). But without the necessity of a land connection, when in Tertiary times the New Zealand land area extended as far as Lord Howe Island, and perhaps New Caledonia, a few earthworms and other animals may have been carried across the intervening comparatively narrow sea by birds and on floating timber.

New Zealand insects have been much neglected, and some groups have hardly been touched. The Coccids, however, have been admirably worked up by the late Mr. W. M. Maskell, so that a comparison is possible. When we add to Maskell's "Synoptical List of Coccidæ" the forms described in his three subsequent papers (*Trans.* N.Z. Inst., vols. xxviii., xxix., xxx.), and summarise the results, we find that of the 105 species and varieties which have been found in New Zealand, 78 (74 per cent.) appear to be endemic. Of the remaining 27 forms, 13 occur also in Australia. These 13 are widely ranging forms which have been found in other countries—North America, Europe, &c., and occur in New Zealand in greenhouses, and on introduced plants.

Most of them have no doubt been recently introduced to both Australia and New Zealand. Two or three, such as *Icerya purchasi*, may have originally come from Australia. Coccids often multiply and spread very rapidly when introduced to a country where the conditions are favourable to them. The number of forms peculiar to Australia is 202. As regards the distribution of the genera, twenty-three have been found in New Zealand, of which only two are peculiar to that country; two of them have been found in other countries but not in Australia; and two occur in New Zealand and Australia, but not elsewhere. These latter are *Ctenochiton* with eleven species in New Zealand and two in Australia, and *Coelostoma* with five species in New Zealand and three in Australia. This would seem to indicate that New Zealand was the original home of both. The remaining seventeen genera occur in Australia and other countries, most of them being cosmopolitan or almost so. Of the ten genera which have been found, so far, only in Australia, four belong to the sub-family *Brachyscelinae*, which is essentially Australian, four of its five genera, and forty-five species, being found only in Australia, and not one representative of this sub-family occurs in New Zealand. It has often been pointed out that the animals and plants characteristic of Australia are absent from New Zealand, and those of New Zealand from Australia.

A large number of beetles have been described by Capt. Brown ("Manual of New Zealand Coleoptera"); Mr. A. T. Urquhart and others have described many spiders in the *Transactions* of the New Zealand Institute; and Mr. R. W. Fereday has enumerated 617 species of lepidotera in the same publication (vol. xxx. p. 326). When these and the other groups come to be revised, and disentangled, and their affinities worked out, it may be reasonably supposed that the results will accord with what has already been done.

In view of the above facts it is clear that not only is it *not* "probable that the whole of the fauna of New Zealand has been originally derived from that source" (Australia), but that only a small and insignificant portion came thence; that the New Zealand terrestrial fauna, as a whole, is essentially distinct from all others; and that its alliance with the fauna of Australia is extremely slight. As far back as 1880 Captain Hutton pointed out that, "The better the fauna of New Zealand becomes known, the more prominently does it stand out distinct from that of any other country" ("Manual of N.Z. Mollusca," p. 2).

In discussing the affinities of the New Zealand fauna it is fair only to consider those groups which have been revised, for many animals have been recently introduced from Australia, and rapid changes have been going on since settlement began in New Zealand and the Australian Colonies. Also in former times collections often got mixed; naturalists and collectors were not very particular about localities, for they did not then know the immense importance and interest attaching to the distribution of species.

The paucity of New Zealand insects is not by any means so great as has been represented. The reason that so few species have been described in many groups is largely due to the fact that they have been neglected by New Zealand naturalists, rather than that there are few to be found. A diligent worker here

will be amply rewarded by the discovery of many new forms, whatever group he may choose to take in hand. Mr. P. Marshall recently described sixty-six species in a first instalment of New Zealand diptera, fifty-four of which were new (*Trans.* N.Z. Inst., vol. xxviii.).

As the general laws regarding the distribution of species can only be discovered from the knowledge of a very great number of facts, I fully agree with the Rev. T. Blackburn that "the special task to be accomplished by this generation, and in the present state of knowledge, is that of collecting and recording *facts and data*" (Presidential Address, *Trans.* Roy. Soc. South Australia, 1891, vol. xiv. p. 371); and that when we attempt to generalise we find how very little is known in comparison to what is yet to be discovered, and feel "the need of that exhaustive collection of the data and records of the facts that we are at present engaged in procuring." Nevertheless, I cannot concur in the suggestion that we should altogether relegate "the investigation of the *reasons* of the facts of nature" to the naturalists of the next generation. Not only is it even now exceedingly interesting and important to summarise what we do know and to understand the direction in which our observations are tending, but it also makes all future work immensely more interesting, and enables the work to be carried out more intelligently and thoroughly. It is, however, very necessary when recording facts to have the mind free from all theories and preconceived ideas which might in any way influence one's observations and conclusions. H. FARQUHAR.

Wellington, N.Z.

The Resistance of the Air.

REFERRING to Mr. Bryan's summary, on page 107 of the current volume of NATURE, of the observations on the resistance of the air, made by Le Dantec and by Canovetti, it is but fair to say that the conclusion "No. 3," viz. that the resistance to a plane surface depends upon its contour, *i.e.* whether circular, square or triangular, is by no means new. Precisely this result was deduced by Prof. Hagen, of Berlin, in his most delicate experiments published by the Berlin Academy in 1874. His memoir is the first in Abbe's collection of translations, entitled "The Mechanics of the Earth's Atmosphere," and a detailed discussion of his results is given at pp. 234–238 of his "Treatise on Meteorological Apparatus and Methods." Hagen's results, when expressed in grams, decimetres and seconds, give the resistance per square decimetre as $(0{\cdot}00707 + 0{\cdot}0001125\,p)\,v^2$ where p is the contour of the plate and v the velocity. As his experiments were made with plates of only from 1 to 12 decimetres on a side, and as he showed that the size affects the coefficient quite as much as the shape, it would scarcely be proper to exterpolate from his small plates up to the large ones used by the French investigators. We should not expect any close agreement for a surface of one metre square between Hagen's figures and these newer ones, but the general law that the pressure per square unit depends upon both the size and the shape of the plate is due to Hagen. The explanation of this result is also largely due to him; it is not merely a question of gaseous viscosity or internal friction, but especially of that dissipation of energy that occurs in the ideal perfect fluid, and which has been called convective friction in the above-mentioned treatise and elsewhere. Le Dantec and Canovetti, by experimenting on a large scale, have necessarily encountered such irregularities and difficulties as must have limited the accuracy of their results quite as much as in the case of many other experiments since those of Sir Isaac Newton. In general, inasmuch as resistance per square unit varies with the size and shape of plane plates or other bodies, it can hardly be called an important physical constant of great scientific interest. It certainly has a practical interest to the aeronaut, the navigator, and the millwright, but the scientific interest of such experiments consist essentially in determining the lines of flow and the transformations of energy involved in the discontinuous motions. C. A.

Washington, December 13, 1899.

THE object of my notice was to give a general account of Le Dantec's and Canovetti's experiments, and certainly not to deliver judgment on those delicate questions of priority which are mainly of personal interest. The "law of perimeters" being so noticeably put forward as a new result, I could do no less than cite the views of Le Dantec and his referee, between whom and Hagen or his advocate "C. A." the matter must rest. There is surely a contradiction of terms in your correspondent's expression, "that dissipation of energy that occurs in the ideal perfect fluid, and which has been called convective friction in the above-mentioned treatise and elsewhere." A fluid which dissipates energy, especially by means of anything called friction, is not an "ideal perfect fluid" according to universally accepted definitions. As to the "scientific interest" of determinations, not only of the aërial resistance of a square metre, but also of the weight of a cubic centimetre of water, the so-called mechanical equivalent of heat, the electrical resistance of a copper wire, the E.M.F. of a Clark cell, or any other physical quantity whose value is affected by various conditions, this surely is a matter of opinion; but the great amount of attention which is now devoted to accumulating statistical data of this class is sufficient indication of a general consensus of opinion in favour of such researches being regarded as valuable from a scientific standpoint. G. H. BRYAN.

Grey's Rock Paintings.

IN Prof. Haddon's review of Mr. Mathews' "Eaglehawk and Crow" there are several references to Grey's rock paintings, amongst which your reviewer remarks, "These rock paintings are certainly very puzzling, and deserve renewed investigation on the spot." They were investigated by Mr. A. C. Gregory, the Australian explorer, who, about seventeen years ago, gave me the following particulars relating to them:—

"The importance of the native coloured drawings, published by Grey in his "Travels," is much exaggerated. The colours are by no means so bright as printed, and the drawings are generally of a very primitive kind, more or less crude outlines of hands or weapons placed on the face of rocks, and lines marked round the edge of the object" (see *Jour. Anth. Inst.*, xvi., p. 133). I have also a clear remembrance of Mr. Gregory blaming the printers for attempting to make comparatively finished drawings of the faces out of crude outlines much in the same way as was so commonly done in the elaborate plates that accompany the volumes of Cook's "Voyages." Mr. Mathews' "identification" may therefore be dismissed. H. LING ROTH.

Halifax, Yorks., January 1.

Evidence of Upheaval in Vanua Levu, Fiji.

DURING an examination of the geology of this large island evidence of very extensive upheaval frequently came under my observation. Speaking generally, the main elevated mass of the island is the product of submarine fissure-eruptions. Its surface is in great part traversed by mountainous ridges, which form an intricate system, and consist in each case of an axis of basic and often coarsely crystalline volcanic rocks concealed beneath calcareous tuffs and volcanic muds, which in their turn are covered over by agglomerates. During the movement of upheaval, and in the ages that have since elapsed, the denuding agencies have been so actively at work that it is not easy to restore the original form of the surface; but it may be observed that in the eighteen months of my stay no evidence of a crateral cavity came under my notice in the main mass of the island. By studying the contours it can be shown that Vanua Levu has been formed by the union during the process of upheaval of a number of smaller islands with a central larger island.

Foraminiferous and pteropod-bearing muds together with calcareous volcanic tuffs are not infrequent up to elevations of 1100 or 1200 feet. They are of scanty occurrence at greater heights; but they are to be found in different parts of the island at elevations of from 1500 to 2000 feet; and in one locality I found sea-shells in a coarse tuff at 2200 feet. Elevated coral-reefs have taken a very little part in the building-up of the island. They exist in a few localities at the coast, and do not attain a higher level than some 200 feet. In this connection it should be noted that flints and silicified corals occur on the surface of the lower regions all over the island. Corals in various stages of silicification are found in quantities in some places, especially where a low-lying district now marks the situation of what was once an inland sea. H. B. GUPPY.

R. C. Mission, Rewa, Fiji, November 21, 1899.